

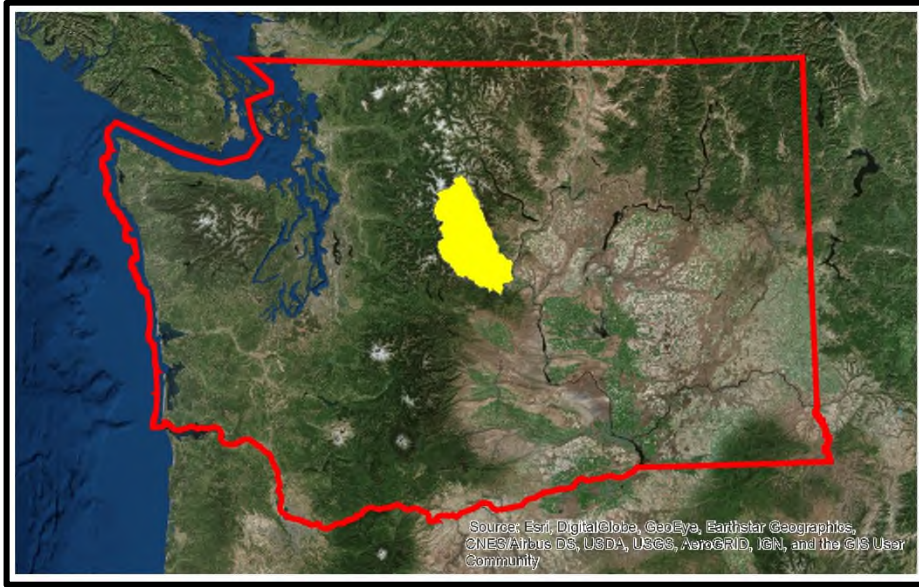
BIOACCUMULATION OF PCBS UNDER DIFFERENT RIVER FLOW REGIMES



William Hobbs

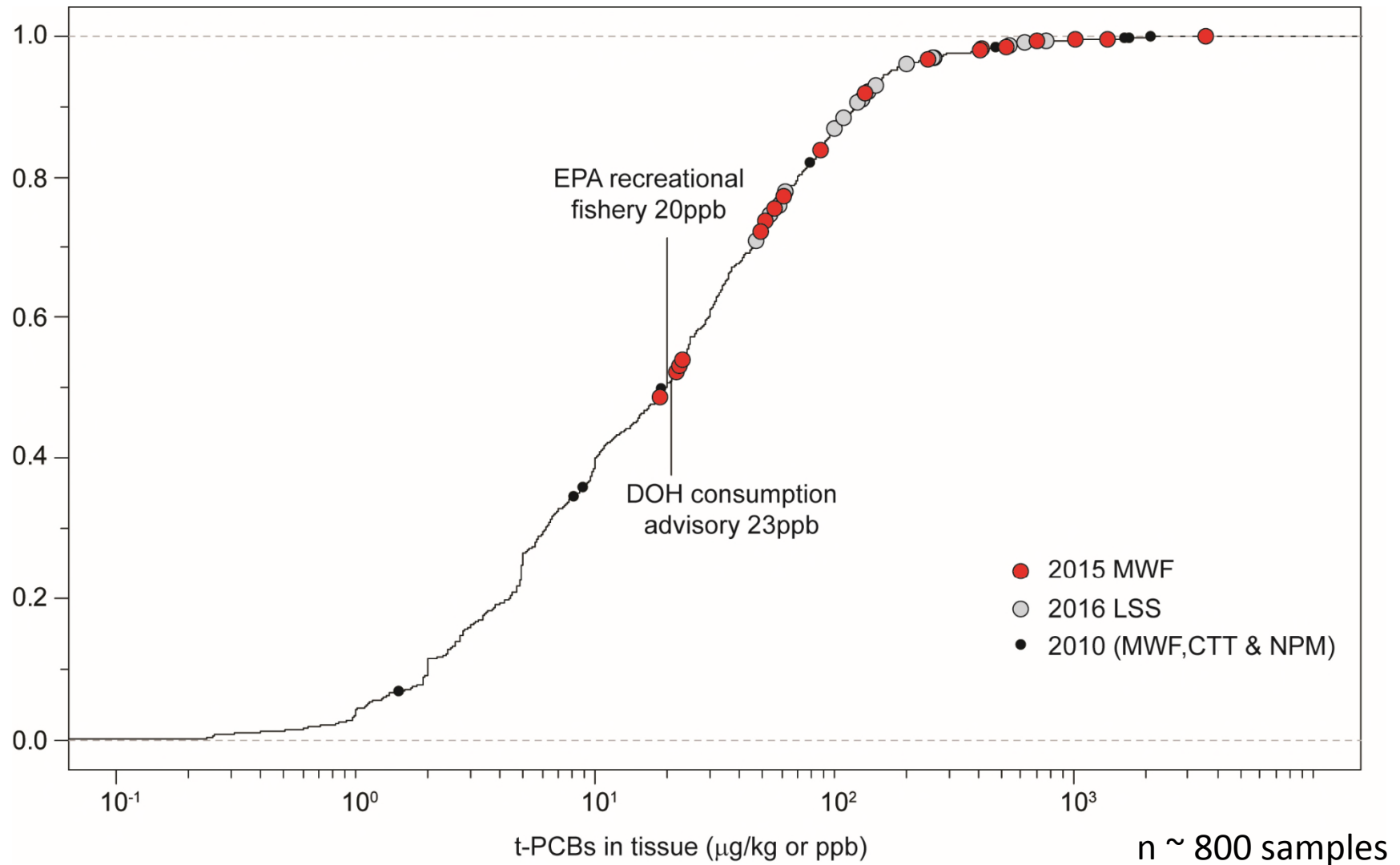
Washington State Department of Ecology

Wenatchee River, Washington State, USA



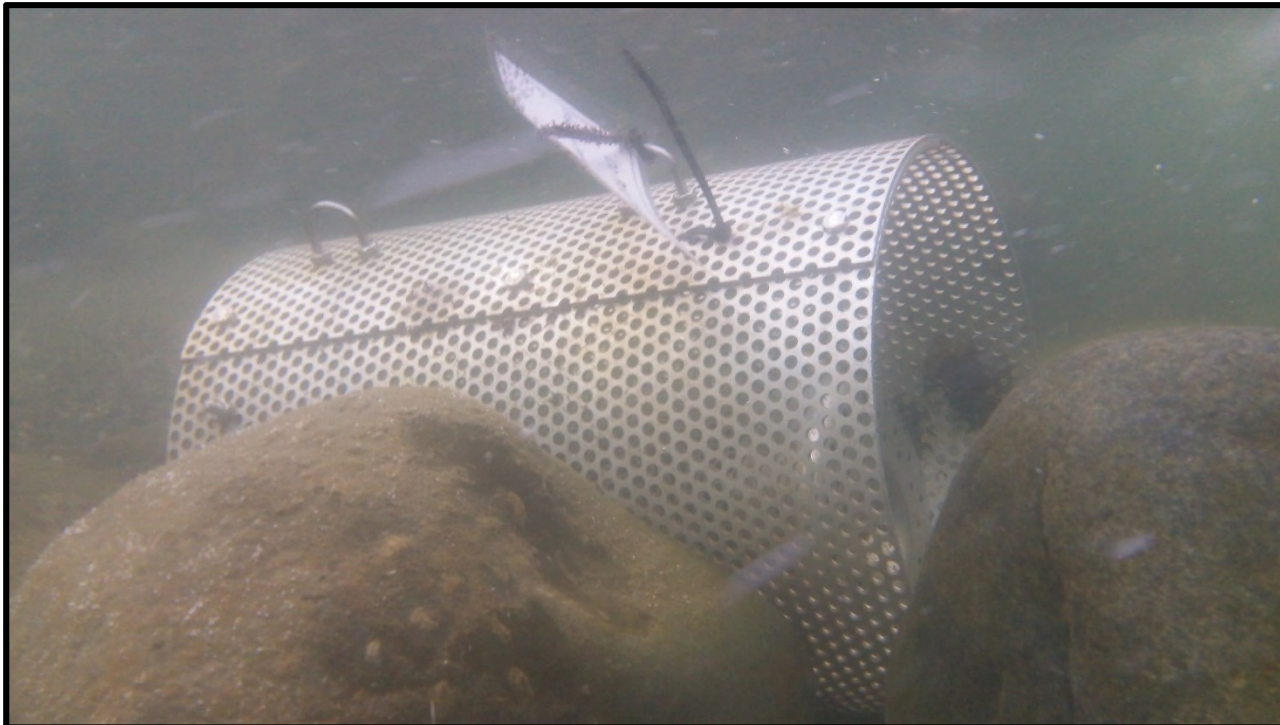
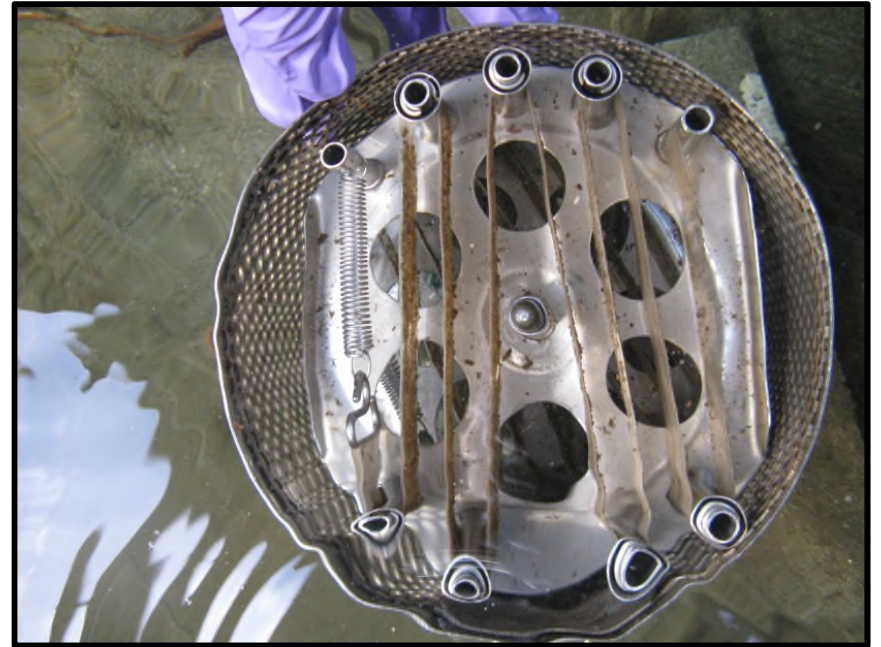
PCBs in fish tissue

- Mountain whitefish (*Prosopium williamsoni*) from the Wenatchee River have some of the highest PCB concentrations in Washington State



Passive samplers

- Sampling from 2014-2017
- Semi-permeable membrane devices
- One-month deployment
- High and low flow periods

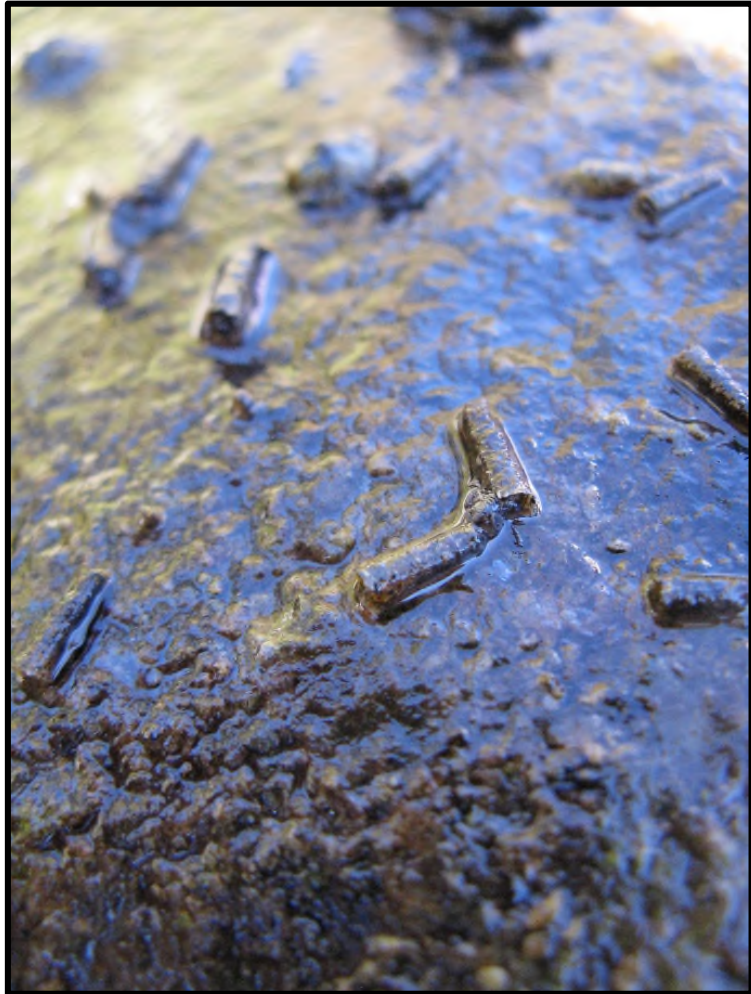


Biofilm Sampling

- Algae, microbial communities, and sediment.
- Base of the river food web
- Chemical concentrations strongly correlated to water ($r^2=0.8$; $p<0.001$)



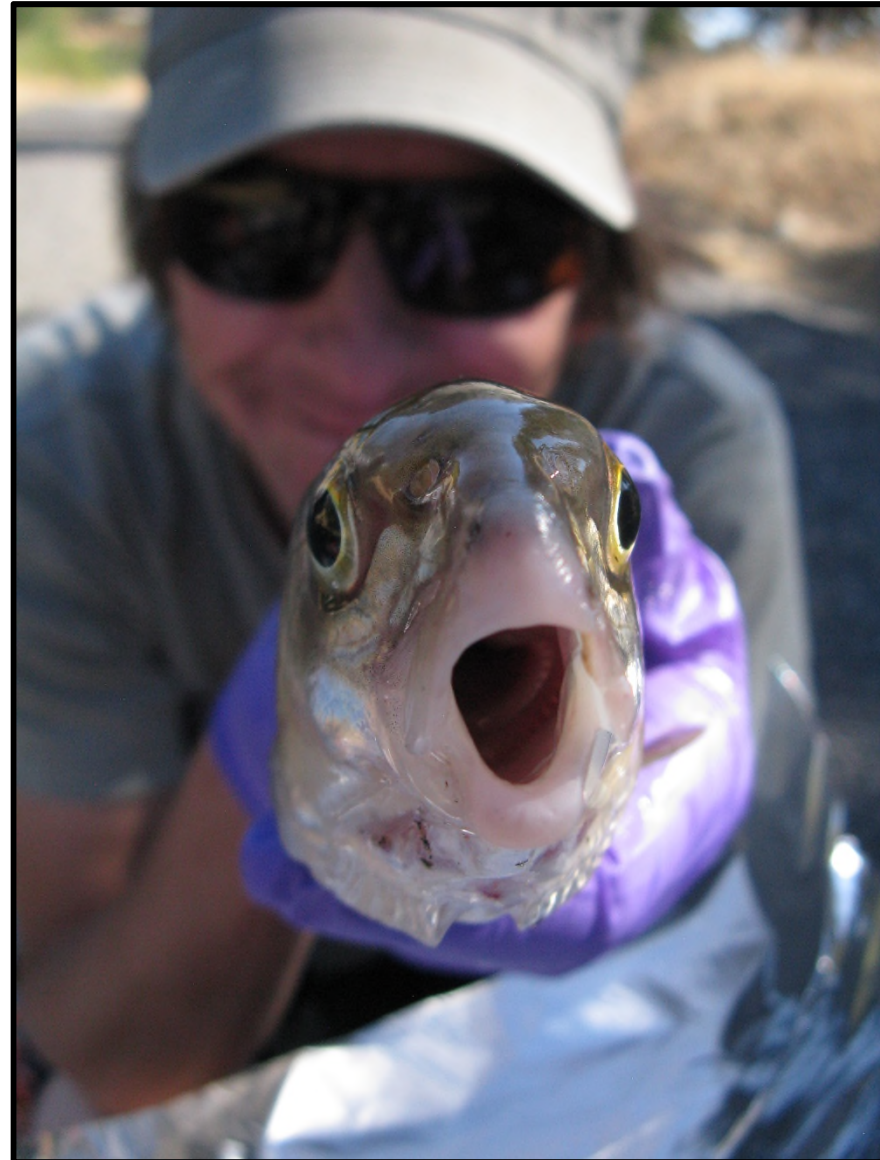
Invertebrate Sampling



- Diet of the mountain whitefish is caddis fly and mayfly.
- Confirmation of diet by gut analysis
- Invertebrate samples composed of caddis fly and mayfly picked from river.

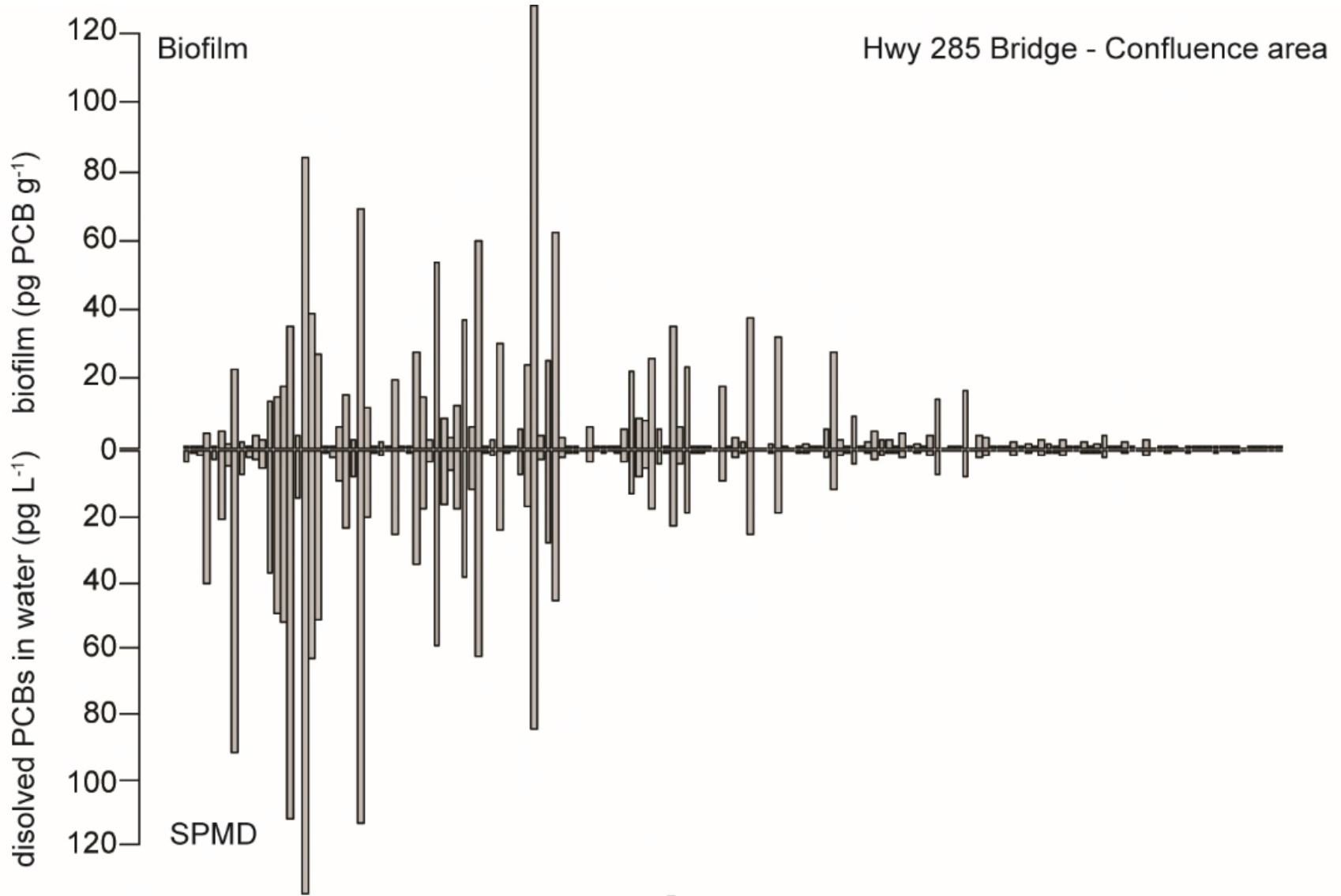
Whitefish and Largescale Sucker sampling

- Individuals and 5-fish composite tissue samples from two river reaches.



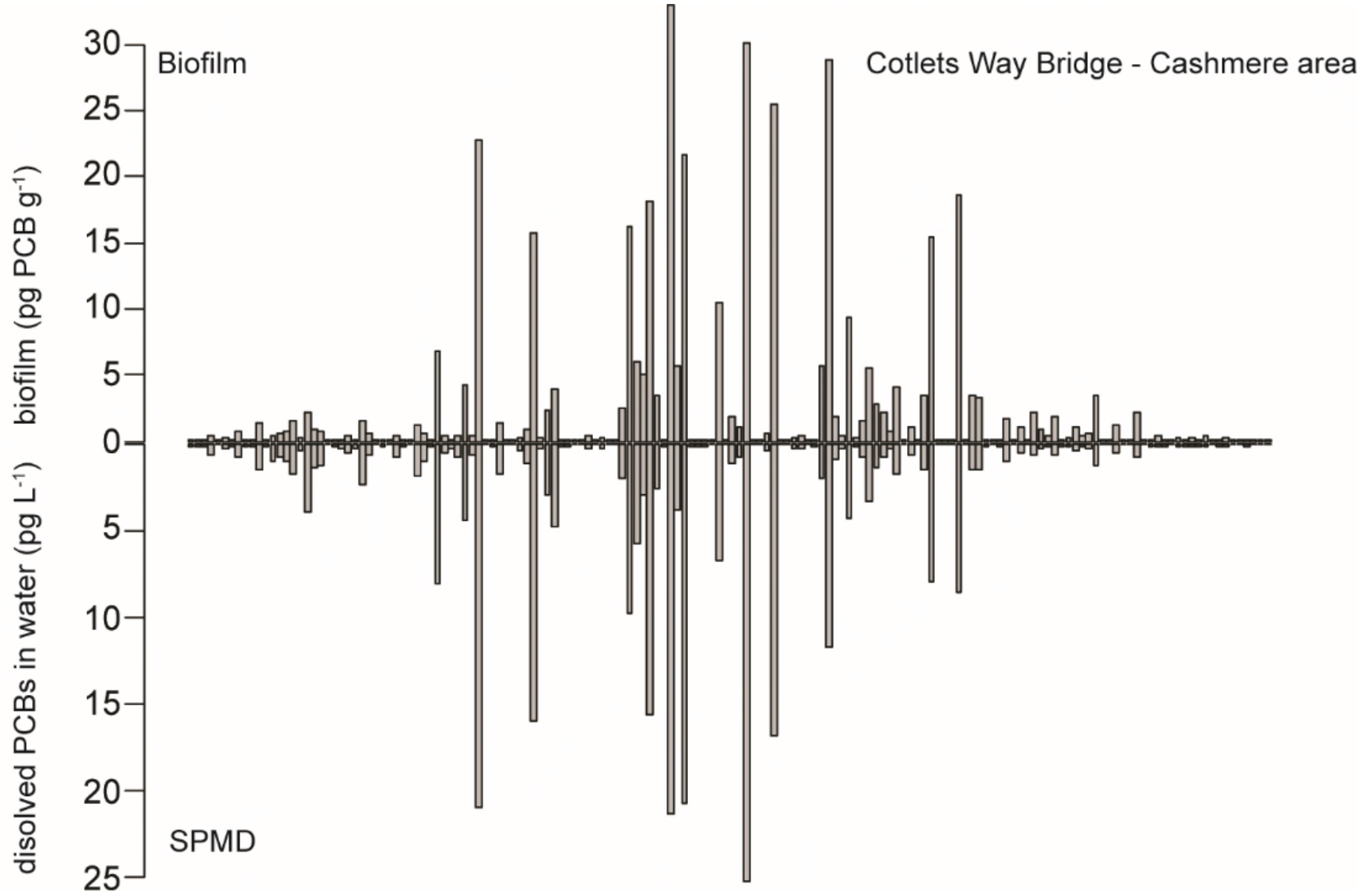
PCB Sources

- Very similar congener distribution between periphytic biofilms and dissolved in water



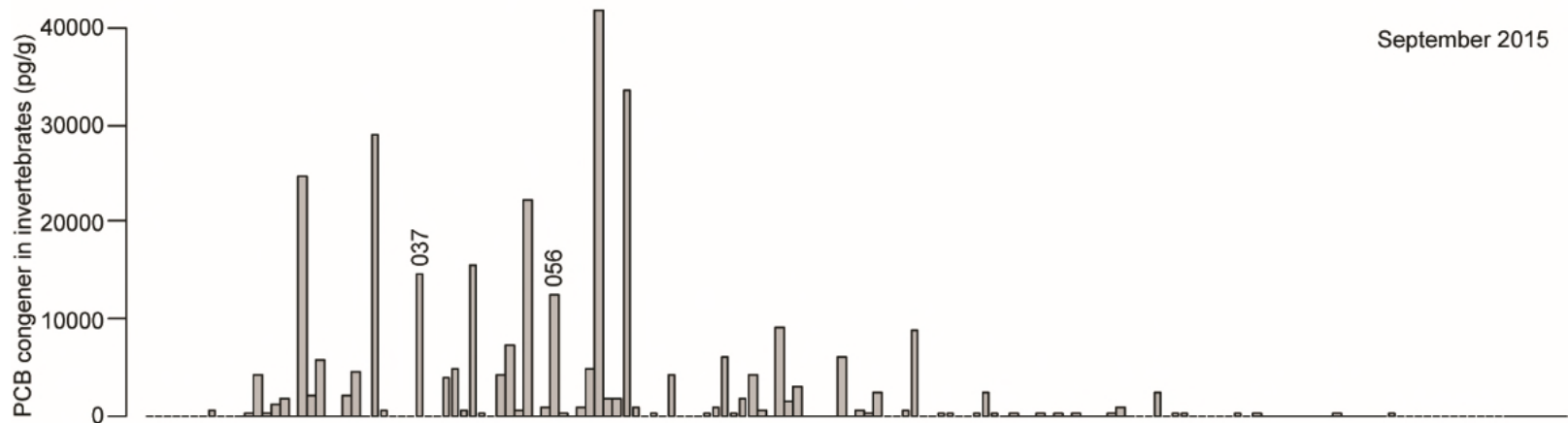
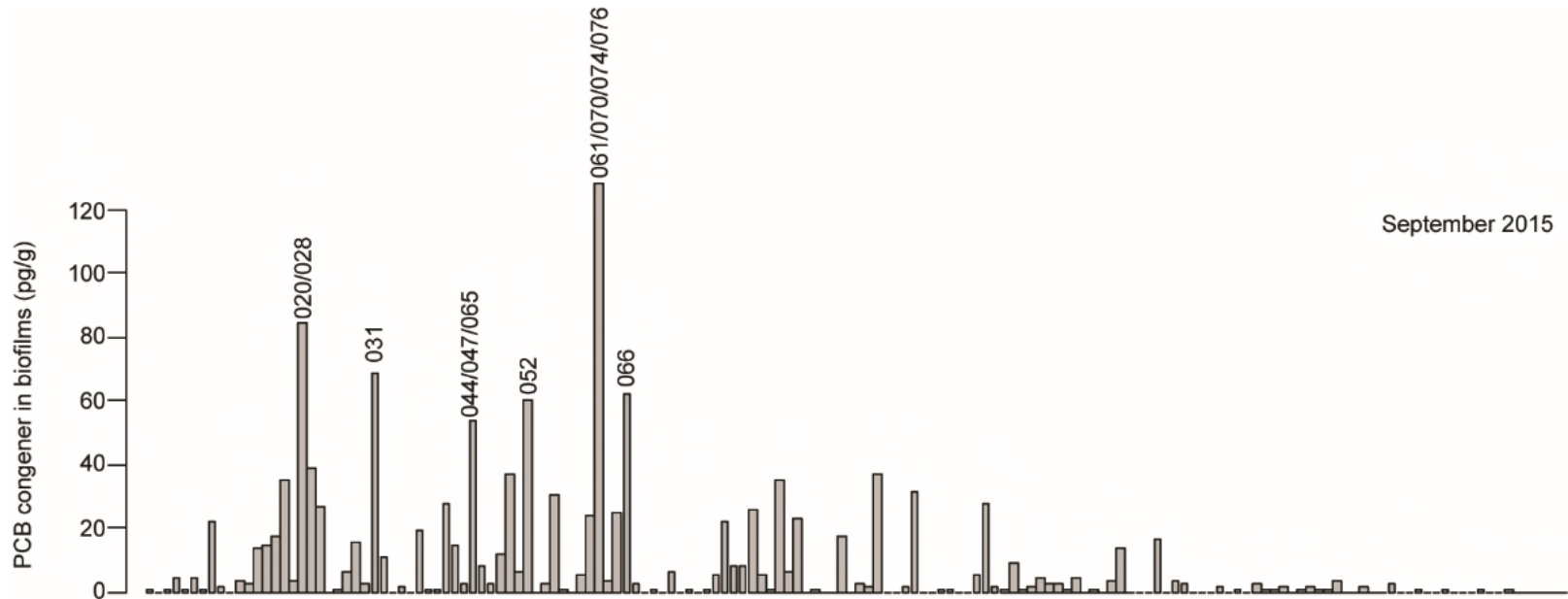
Two PCB Sources

- Different distribution between upstream and downstream locations = different sources



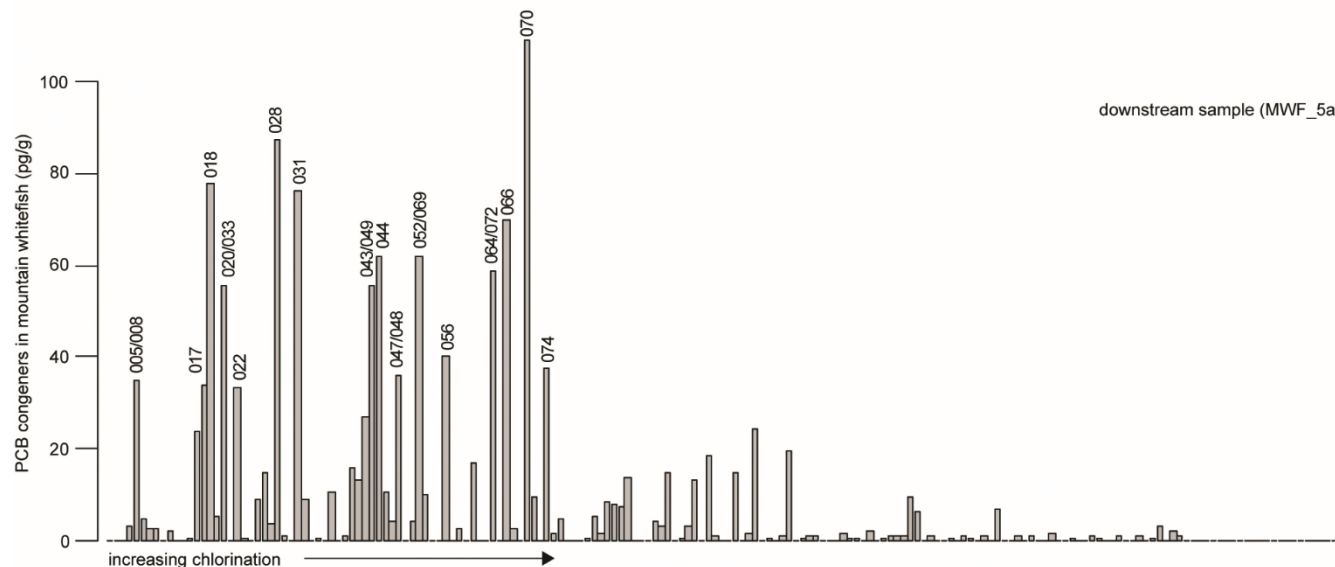
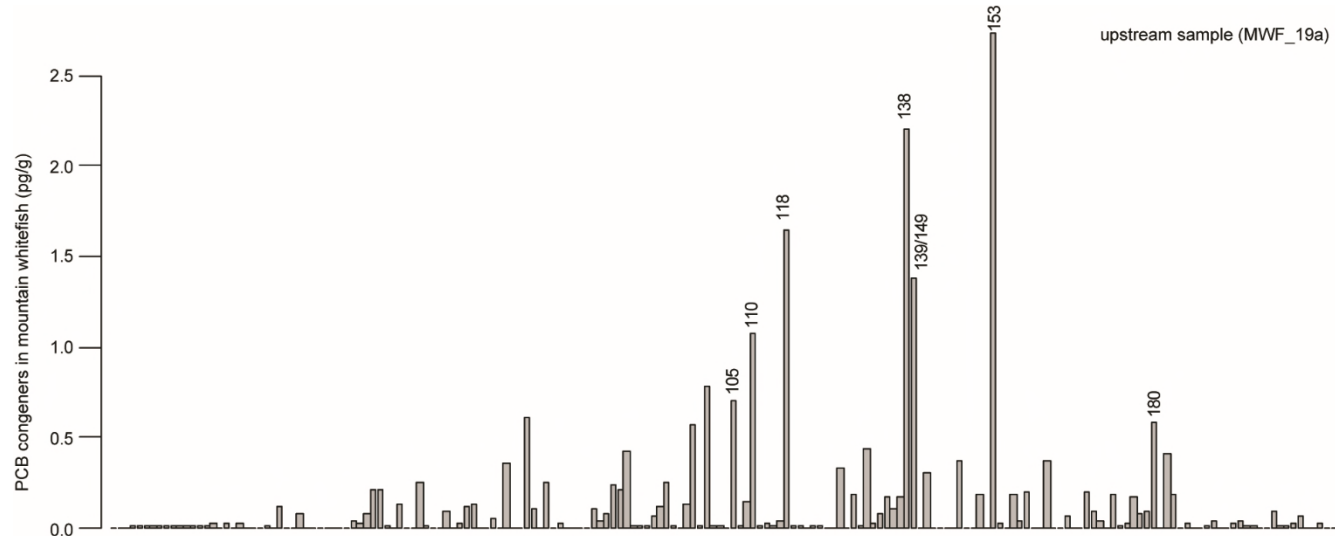
PCB fingerprint of primary producer and consumer

- invertebrates have similar profile to biofilm (food source)



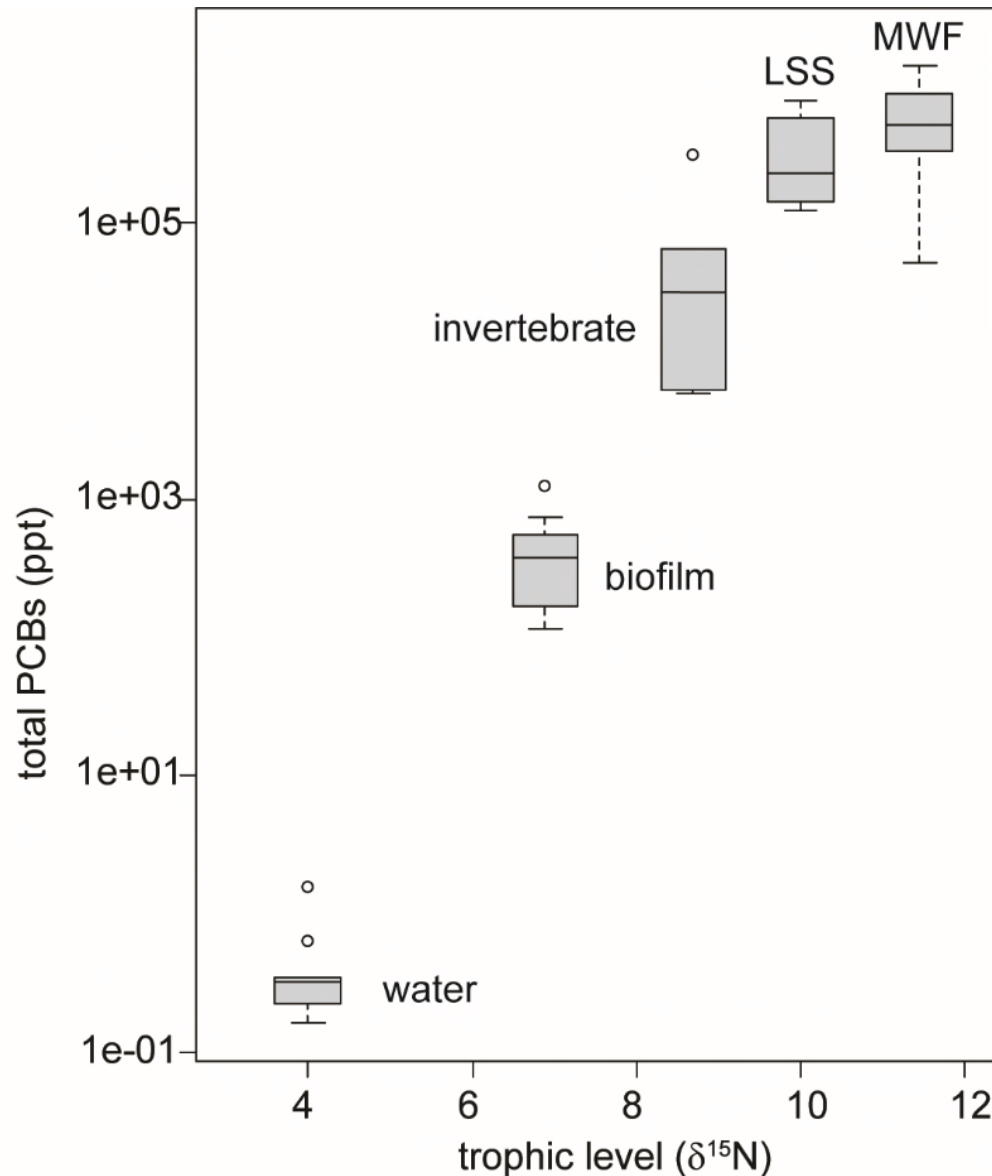
PCB fingerprint for the source areas

- MWF caught from different areas reflect food source



- Both 3-yr old MWF
- Similar fat content
- Downstream fish has higher PCB concentrations
- Stable isotope work also reflects contaminant source areas

Bioaccumulation in the river food web



- largest biomagnification from water to biofilm
- LSS = largescale suckers (benthic feeder); MWF = mountain whitefish (top consumer)
- overlap of PCB concentrations in sucker and whitefish; possibly because suckers were older.

PCB Sources in the Wenatchee

- Two chemically distinct PCB sources

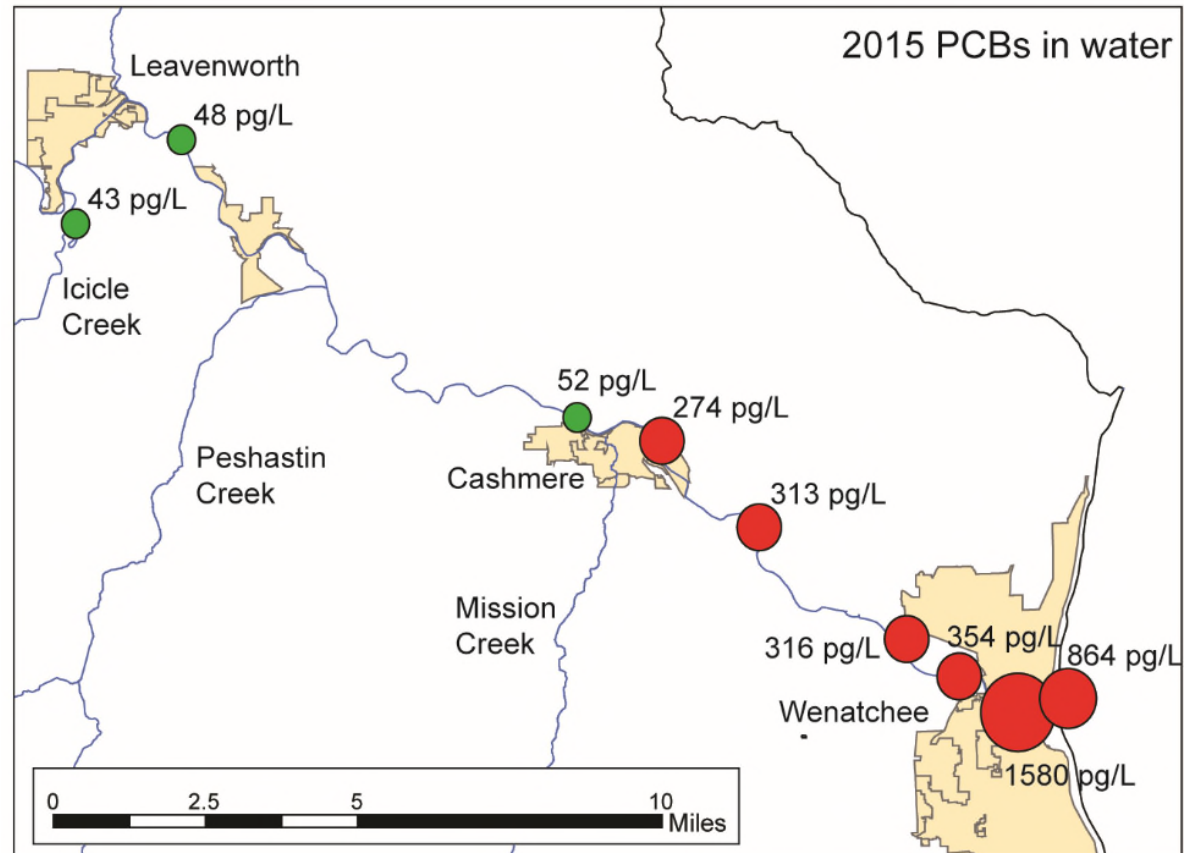
Upstream Source

- Congener profile does resemble Aroclor 1254

Downstream Source

- Congener profile resembles Aroclor 1242/1248 with congeners that suggest microbial dechlorination.

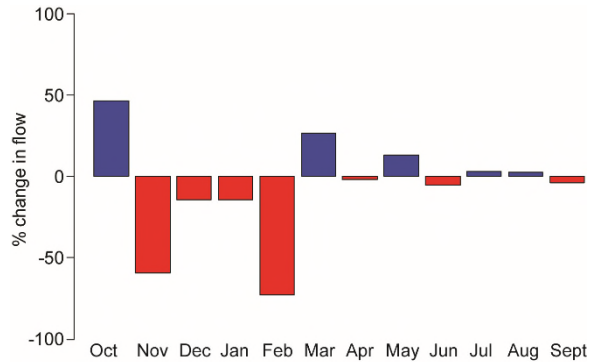
- Largest biomagnification from water – biofilm (~1600 fold)
- Same congener profile over time and at low and high flow = **constant source** (i.e. not stormwater); likely groundwater inputs



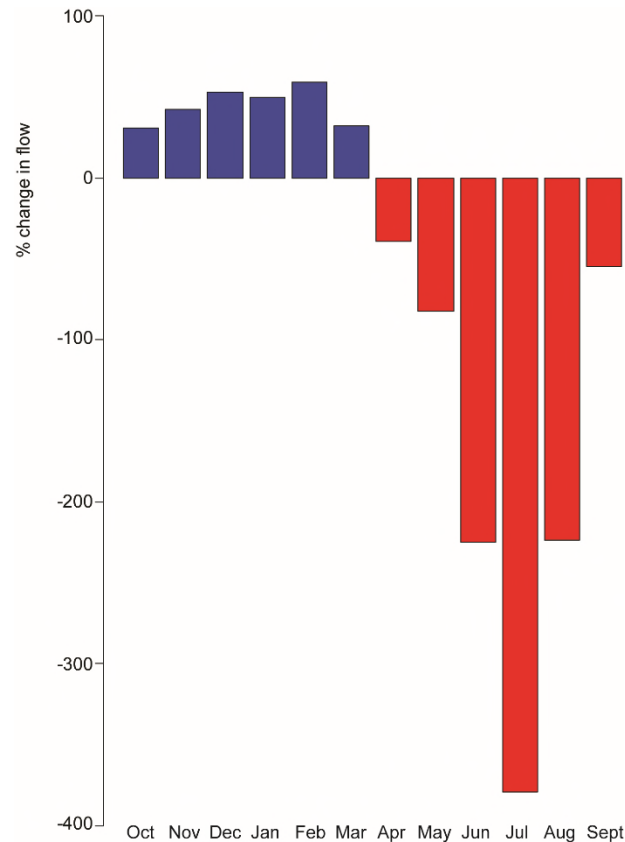
Hydrology - % change in discharge from normal

- 2015 exhibited higher flow in winter and early spring; much lower flow in the summer.

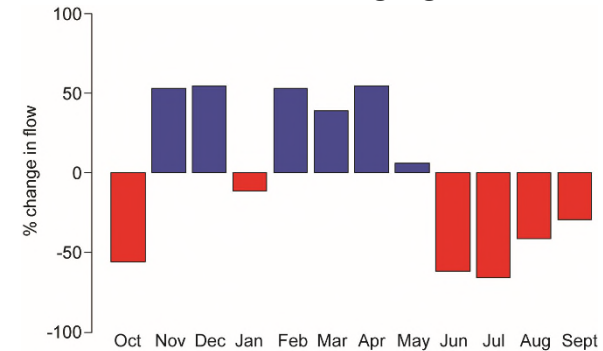
WY 2014



WY 2015



WY 2016

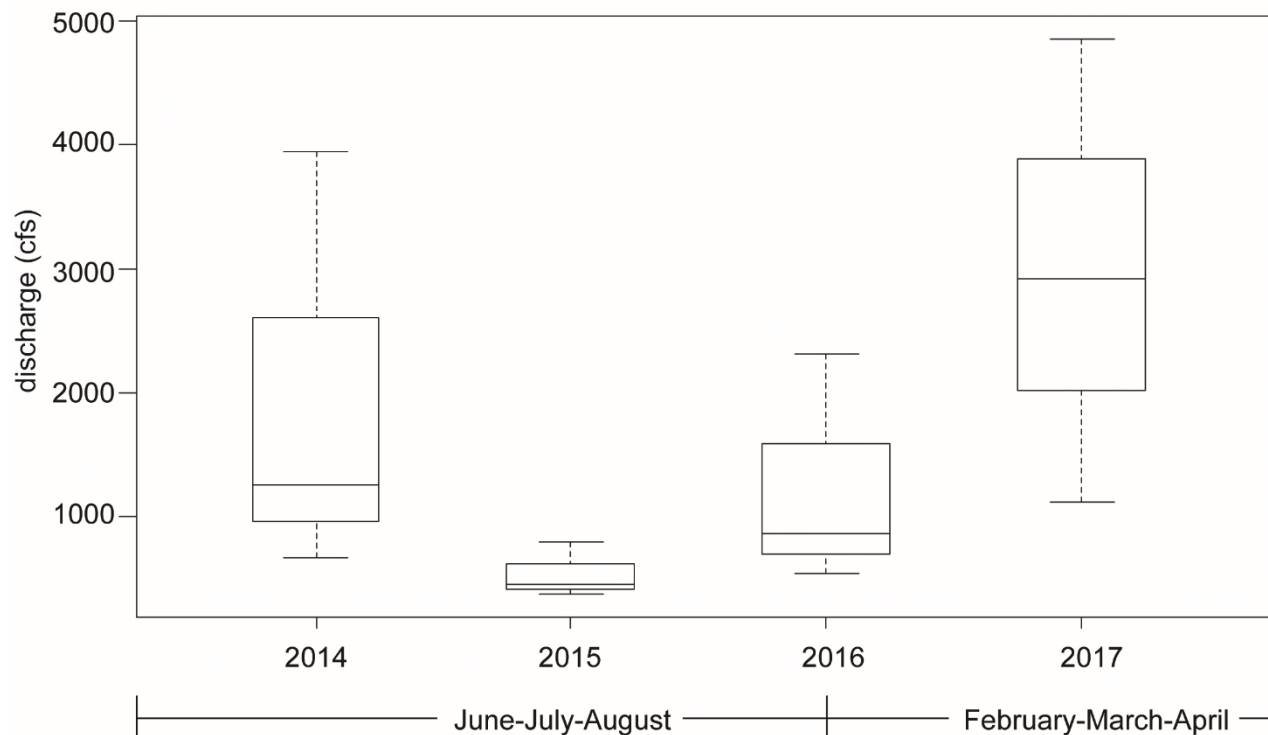
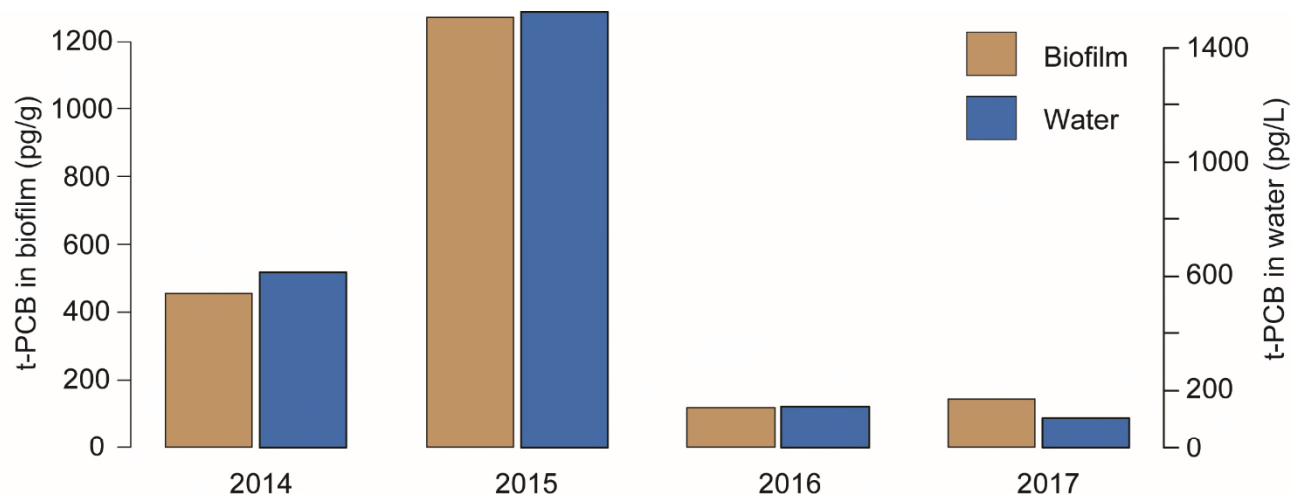


Low flow = higher PCB accumulation

- Higher PCB concentrations in water, biofilms and invertebrates in 2015.

Invertebrate tissues (ng/g)	
2015	2016
315.0	6.1

- Sustained low flow in the summer months of 2015

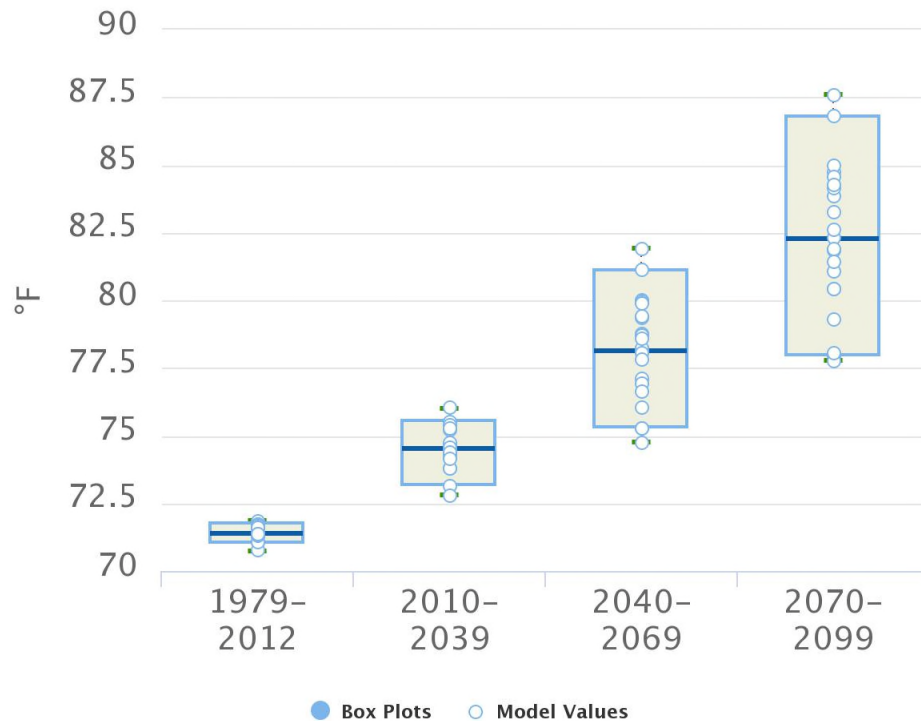


Predicted Changes in Flow

- 2015 exhibited characteristics of projected climate changes.
- future scenarios suggest prolonged periods of lower flow in the summer.

Jun-July-Aug Mean Temperature

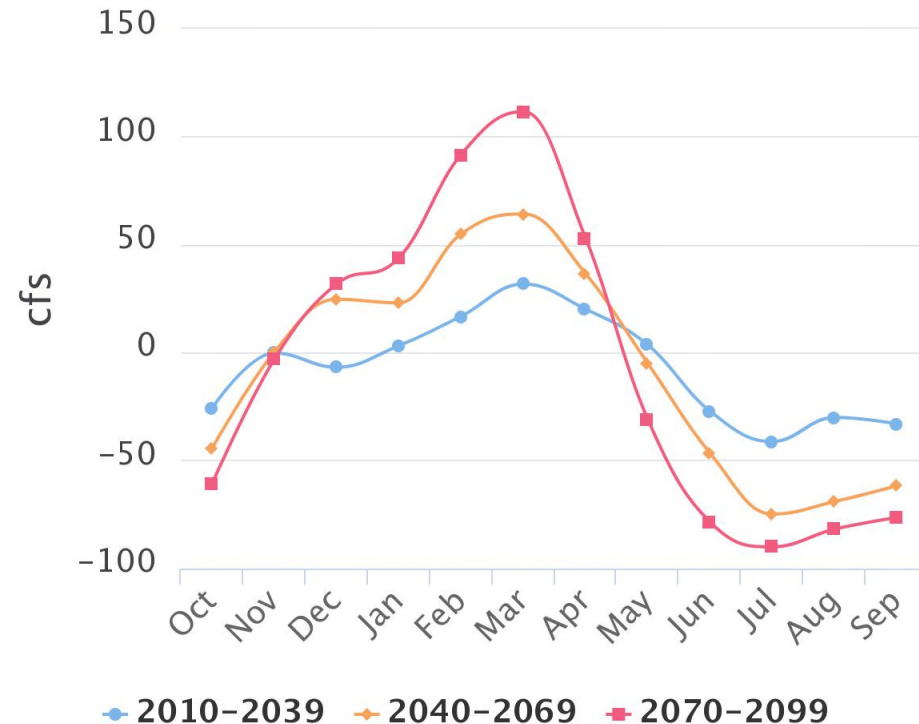
High Emissions Modeled Climate, Wenatchee, WA



NW Climate Toolbox, Data: MACAv2-METDATA, RCP8.5

Projected Streamflow (RCP 8.5)

American River Near Nile, WA



Climate Toolbox, Source: VIC-MACAv2-Livneh CMIP5 Multi-Model Mean Bias-Corrected

Take-home

With continuous PCB sources, prolonged periods of lower river flow could yield higher PCB bioaccumulation in the river food web.

Continued Source Investigation

- groundwater and contaminant hotspots



Acknowledgments

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